

# IrDA® Data Compliant 115.2 kb/s 3 V to 5 V Infrared Transceiver

## Technical Data

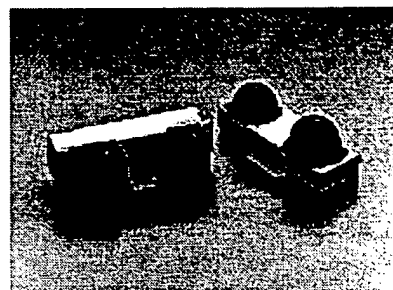
HSDL-3610#007  
HSDL-3610#008

### Features

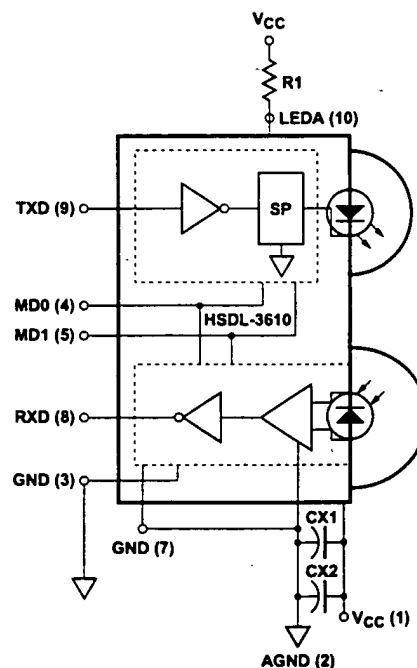
- **Fully Compliant to IrDA 1.0 Physical Layer Specifications**
  - 9.6 kb/s to 115.2 kb/s operation
- **Typical Link Distance > 1.5 m**
- **Compatible with HP-SIR and TV Remote**
- **IEC825-Class 1 Eye Safe**
- **Low Power Operation Range**
  - 2.7 V to 5.25 V
- **Small Module Size**
  - 4.0 x 12.2 x 5.1 mm (HxWxD)
- **Complete Shutdown**
  - TXD, RXD, PIN diode
- **Low Shutdown Current**
  - 10 nA typical
- **Adjustable Optical Power Management**
  - Adjustable LED drive- current to maintain link integrity
- **Integrated EMI Shield**
  - Excellent noise immunity
- **Edge Detection Input**
  - Prevents the LED from long turn-on time
- **Interface to Various Super I/O and Controller Devices**
- **Designed to Accommodate Light Loss with Cosmetic Window**
- **Only 2 External Components are Required**

### Applications

- **Digital Imaging**
  - Digital Still Cameras
  - Photo-Imaging Printers
- **Data Communication**
  - Notebook Computers
  - Desktop PCs
  - Win CE Handheld Products
  - Personal Digital Assistants (PDAs)
- **Printers**
- **Fax Machines, Photocopiers**
- **Screen Projectors**
- **Auto PCs**
- **Dongles**
- **Set-Top Box**
- **Telecommunication Products**
  - Cellular Phones
  - Pagers
- **Small Industrial & Medical Instrumentation**
  - General Data Collection Devices
  - Patient & Pharmaceutical Data Collection Devices



### Functional Block Diagram



### Description

The HSDL-3610 is a low-profile infrared transceiver module that provides interface between logic and IR signals for through-air, serial, half-duplex IR data link. The module is compliant to IrDA Data Physical Layer Specifications 1.0 and IEC825-Class 1 Eye Safe.

The HSDL-3610 contains a high-speed and high-efficiency 870 nm LED, a silicon PIN diode, and an integrated circuit. The IC contains an LED driver and a receiver providing a single output (RXD) for all data rates supported.

The HSDL-3610 can be completely shut down to achieve very low power consumption. In the shut down mode, the PIN diode will be inactive and thus producing very little photo-current even under very bright ambient light. The HSDL-3610 also incorporated the capability

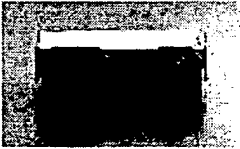
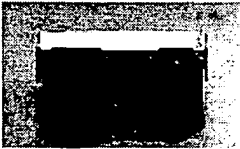


for adjustable optical power. With two programming pins; MODE 0 and MODE 1, the optical power output can be adjusted lower when the nominal desired link distance is one-third or two-third of the full IrDA link.

The HSDL-3610 comes in two package options; the front view option (HSDL-3610#007/#017), and the top view option (HSDL-3610#008/#018). Both options come with integrated shield that helps to ensure low EMI emission and high immunity to EMI field, thus enhancing reliable performance.

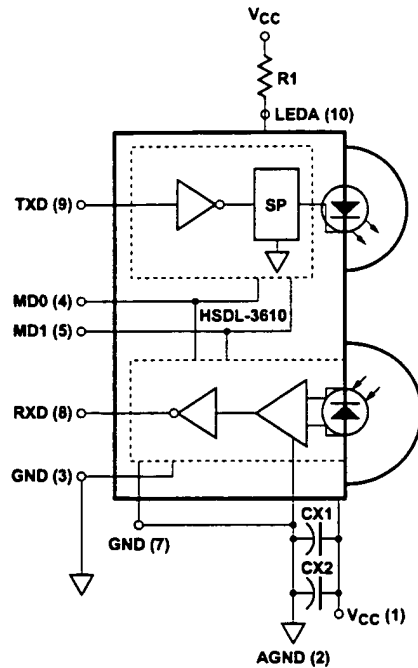
### Application Support Information

The Application Engineering group is available to assist you with the technical understanding associated with HSDL-3610 infrared transceiver module. You can contact them through your local sales representatives for additional details.

### Ordering Information

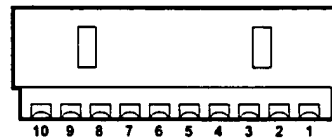
| Package Option  | Package    | Part Number   | Standard Package Increment |
|---|------------|---------------|----------------------------|
|  | Front View | HSDL-3610#007 | 400                        |
|  | Front View | HSDL-3610#017 | 10                         |
|  | Top View   | HSDL-3610#008 | 400                        |
|  | Top View   | HSDL-3610#018 | 10                         |

## Functional Block Diagram

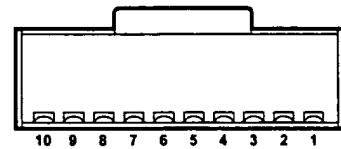


## I/O Pins Configuration Table

| Pin | Description            | Symbol |
|-----|------------------------|--------|
| 1   | Supply Voltage         | Vcc    |
| 2   | Analog Ground          | AGND   |
| 3   | Ground                 | GND    |
| 4   | Mode 0                 | MD0    |
| 5   | Mode 1                 | MD1    |
| 6   | No Connection          | NC     |
| 7   | Ground                 | GND    |
| 8   | Receiver Data Output   | RXD    |
| 9   | Transmitter Data Input | TXD    |
| 10  | LED Anode              | LEDA   |



BACK VIEW (HSDL-3610 #007/#017)



BOTTOM VIEW (HSDL-3610 #008/#018)

## Transceiver Control Truth Table

| Mode 0 | Mode 1 | RX Function | TX Function         |
|--------|--------|-------------|---------------------|
| 1      | 0      | Shutdown    | Shutdown            |
| 0      | 0      | SIR         | Full Distance Power |
| 0      | 1      | SIR         | 2/3 Distance Power  |
| 1      | 1      | SIR         | 1/3 Distance Power  |

X = Don't Care

## Transceiver I/O Truth Table

| Transceiver Mode | Inputs           |                     | Outputs   |                    |
|------------------|------------------|---------------------|-----------|--------------------|
|                  | TXD              | EI                  | LED       | RXD                |
| Active           | 1                | X                   | On        | Not Valid          |
| Active           | 0                | High <sup>[1]</sup> | Off       | Low <sup>[2]</sup> |
| Active           | 0                | Low                 | Off       | High               |
| Shutdown         | X <sup>[3]</sup> | Low                 | Not Valid | Not Valid          |

X = Don't Care      EI = In-Band Infrared Intensity at detector

### Notes:

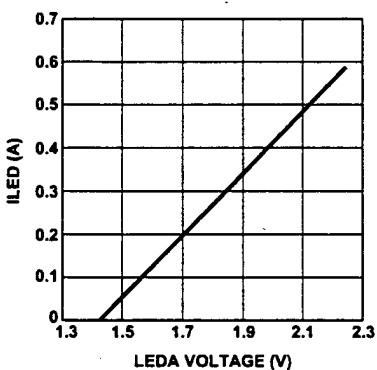
1. In-Band EI  $\leq 115.2$  kb/s.
2. Logic Low is a pulsed response. The condition is maintained for duration dependent on the pattern and strength of the incident intensity.
3. To maintain low shutdown current, TXD needs to be driven high or low and not left floating.

### Recommended Application Circuit Components

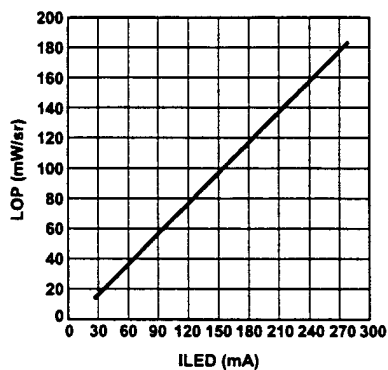
| Component          | Recommended Value   |
|--------------------|---|
| R1                 | 6.2 $\Omega \pm 5\%$ , 0.5 Watt, for 2.7 $\leq V_{CC} \leq 3.6$ V operation<br>15.0 $\Omega \pm 5\%$ , 0.5 Watt, for 4.75 $\leq V_{CC} \leq 5.25$ V operation |
| CX1 <sup>[5]</sup> | 0.47 $\mu\text{F} \pm 20\%$ , X7R Ceramic   |
| CX2 <sup>[6]</sup> | 6.8 $\mu\text{F} \pm 20\%$ , Tantalum   |

**Notes :**

- CX1 must be placed within 0.7 cm of the HSDL-3610 to obtain optimum noise immunity.
- In environments with noisy power supplies, supply rejection performance can be enhanced by including CX2, as shown in "HSDL-3610 Functional Block Diagram" in page 3.



**ILED vs. LEDA.**



**Light Output Power (LOP) vs. ILED.**

### Marking Information

The HSDL-3610#007/017 is marked "3610YYWW" on the shield where "YY" indicates the unit's manufacturing year, and "WW" refers to the work week in which the unit is tested.

The HSDL-3610#008/018 has no marking on the shield.

**CAUTIONS:** The BiCMOS inherent to the design of this component increases the component's susceptibility to damage from electrostatic discharge (ESD). It is advised that normal static precautions be taken in handling and assembly of this component to prevent damage and/or degradation which may be induced by ESD.

### Absolute Maximum Ratings<sup>[6]</sup>

| Parameter                      | Symbol               | Minimum | Maximum              | Unit | Conditions                              |
|--------------------------------|----------------------|---------|----------------------|------|---|
| Storage Temperature            | T <sub>S</sub>       | -40     | +100                 | °C   |   |
| Operating Temperature          | T <sub>A</sub>       | -20     | +70                  | °C   |   |
| DC LED Current                 | I <sub>LED(DC)</sub> |         | 165                  | mA   |   |
| Peak LED Current               | I <sub>LED(PK)</sub> |         | 750                  | mA   | ≤ 2 μs pulse width,<br>≤ 10% duty cycle |
| LED Anode Voltage              | V <sub>LEDA</sub>    | -0.5    | 7                    | V    |   |
| Supply Voltage                 | V <sub>CC</sub>      | 0       | 7                    | V    |   |
| Transmitter Data Input Current | I <sub>TXD(DC)</sub> | -12     | 12                   | mA   |   |
| Receiver Data Output Voltage   | V <sub>O</sub>       | -0.5    | V <sub>CC</sub> +0.5 | V    | I <sub>O</sub> (RXD)  = 20 μA           |

**Note:**

6. For implementations where case to ambient thermal resistance ≤ 50°C/W.

### Recommended Operating Conditions

| Parameter   | Symbol            | Minimum              | Maximum            | Unit | Conditions  |
|---|-------------------|----------------------|--------------------|------|---|
| Operating Temperature                                   | T <sub>A</sub>    | -20                  | +70                | °C   |   |
| Supply Voltage  | V <sub>CC</sub>   | 2.7                  | 5.25               | V    |   |
| Logic High Input Voltage for TXD, MD0, MD1, and FIR_SEL | V <sub>IH</sub>   | 2 V <sub>CC</sub> /3 | V <sub>CC</sub>    | V    |   |
| Logic Low Transmitter Input Voltage                     | V <sub>IL</sub>   | 0                    | V <sub>CC</sub> /3 | V    |   |
| LED (Logic High) Current Pulse Amplitude                | I <sub>LEDA</sub> | 180                  | 300                | mA   |   |
| Receiver Signal Rate                                    |                   | 2.4                  | 115.2              | kb/s |   |
| Ambient Light   |                   |                      |                    |      | See IrDA Serial Infrared Physical Layer Link Specification, Appendix A for ambient levels |

## Electrical & Optical Specifications

Specifications hold over the Recommended Operating Conditions unless otherwise noted. Unspecified test conditions can be anywhere in their operating range. All typical values are at 25°C and 3.3 V unless otherwise noted.

| Parameter                           |                             | Symbol                    | Min. | Typ. | Max. | Unit    | Conditions  |
|-------------------------------------|-----------------------------|---------------------------|------|------|------|---------|---|
| <b>Transceiver</b>                  |                             |                           |      |      |      |         |   |
| Supply Current                      | Shutdown                    | $I_{CC1}$                 |      | 10   | 200  | nA      | $V_I(TXD) \leq V_{IL}$ or $V_I(TXD) \geq V_{IH}$                        |
|                                     | Idle                        | $I_{CC2}$                 |      | 2.5  | 5    | mA      | $V_I(TXD) \leq V_{IL}$ , $EI = 0$                                       |
| Digital Input Current               | Logic Low/High              | $I_{L/H}$                 | -1   |      | 1    | $\mu A$ | $0 \leq V_I \leq V_{CC}$  |
| <b>Transmitter</b>                  |                             |                           |      |      |      |         |   |
| Transmitter Radiant Intensity       | Logic High Intensity        | $E_{IH}$                  | 50   | 120  | 400  | mW/sr   | $V_{IH} = 3.0 V$<br>$I_{LEDA} = 200 mA$<br>$\theta_{1/2} \leq 15^\circ$ |
|                                     | Peak Wavelength             | $\lambda_p$               |      | 875  |      | nm      |   |
|                                     | Spectral Line Half Width    | $\Delta\lambda_{1/2}$     |      | 35   |      | nm      |   |
|                                     | Viewing Angle               | $2\theta_{1/2}$           | 30   |      | 60   | °       |   |
|                                     | Optical Pulse Width         | tpw (EI)                  | 1.5  | 1.6  | 1.8  | $\mu s$ | tpw(TXD) = 1.6 $\mu s$ at 115.2 kb/s                                    |
|                                     | Rise and Fall Times         | $t_r$ (EI),<br>$t_f$ (EI) |      |      | 40   | ns      | tpw(TXD) = 1.6 $\mu s$ at 115.2 kb/s<br>$t_{r/f}(TXD) = 10 ns$          |
|                                     | Maximum Optical Pulse Width | tpw (max)                 |      | 20   | 50   | $\mu s$ | TXD pin stuck high  |
| LED Anode On State Voltage          |                             | $V_{ON}(LEDA)$            |      |      | 2.4  | V       | $I_{LEDA} = 200 mA$ ,<br>$V_I(TXD) \geq V_{IH}$                         |
| LED Anode Off State Leakage Current |                             | $I_{LK}(LEDA)$            |      | 1    | 100  | nA      | $V_{LEDA} = V_{CC} = 5.25 V$ ,<br>$V_I(TXD) \leq V_{IL}$                |

## Electrical & Optical Specifications

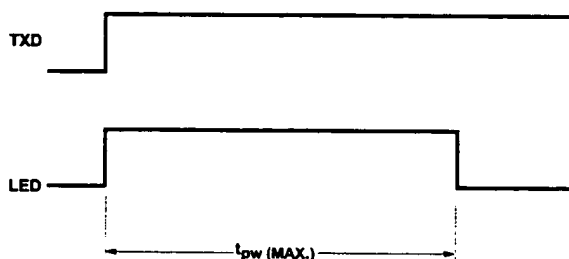
Specifications hold over the Recommended Operating Conditions unless otherwise noted. Unspecified test conditions can be anywhere in their operating range. All typical values are at 25°C and 3.3 V unless otherwise noted.

| Parameter                            |                          | Symbol          | Min.           | Typ. | Max.     | Unit                      | Conditions  |
|--------------------------------------|--------------------------|-----------------|----------------|------|----------|---------------------------|---|
| <b>Receiver</b>                      |                          |                 |                |      |          |                           |   |
| Receiver Data Output Voltage         | Logic Low <sup>[8]</sup> | $V_{OL}$        | 0              | -    | 0.4      | V                         | $I_{OL} = 1.0 \text{ mA}$ ,<br>$EI \geq 3.6 \mu\text{W}/\text{cm}^2$ ,<br>$\theta_{1/2} \leq 15^\circ$  |
|                                      | Logic High               | $V_{OH}$        | $V_{CC} - 0.2$ | -    | $V_{CC}$ | V                         | $I_{OH} = -20 \mu\text{A}$ ,<br>$EI \leq 0.3 \mu\text{W}/\text{cm}^2$ ,<br>$\theta_{1/2} \leq 15^\circ$ |
|                                      | Viewing Angle            | $2\theta_{1/2}$ | 30             |      |          | °                         |   |
| Logic High Receiver Input Irradiance |                          | $E_{IH}$        | 0.0036         |      | 500      | $\text{mW}/\text{cm}^2$   | For in-band signals $\leq 115.2 \text{ kb/s}$ <sup>[7]</sup>  |
| Logic Low Receiver Input Irradiance  |                          | $E_{IL}$        |                |      | 0.3      | $\mu\text{W}/\text{cm}^2$ | For in-band signals <sup>[7]</sup>  |
| Receiver Peak Sensitivity Wavelength |                          | $\lambda_p$     |                | 880  |          | nm                        |   |
| Receiver SIR Pulse Width             |                          | tpw (SIR)       | 1              |      | 4.0      | $\mu\text{s}$             | $\theta_{1/2} \leq 15^\circ$ <sup>[9]</sup> , $C_L = 10 \text{ pF}$                                     |
| Receiver Latency Time                |                          | $t_L$           |                | 20   | 50       | $\mu\text{s}$             |   |
| Receiver Rise/Fall Times             |                          | $t_{r/f}$ (RXD) |                | 25   |          | ns                        |   |
| Receiver Wake Up Time                |                          | tw              |                |      | 100      | $\mu\text{s}$             | [10]  |

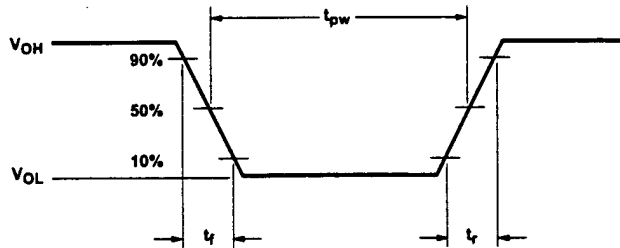
### Notes:

7. An in-band optical signal is a pulse/sequence where the peak wavelength,  $\lambda_p$ , is defined as  $850 \leq \lambda_p \leq 900 \text{ nm}$ , and the pulse characteristics are compliant with the IrDA Serial Infrared Physical Layer Link Specification.
8. Logic Low is a pulsed response. The condition is maintained for duration dependent on pattern and strength of the incident intensity.
9. For in-band signals  $\leq 115.2 \text{ kb/s}$  where  $3.6 \mu\text{W}/\text{cm}^2 \leq EI \leq 500 \text{ mW}/\text{cm}^2$ .
10. Wake Up Time is the time between the transition from a shutdown state to an active state and the time when the receiver is active and ready to receive infrared signals.

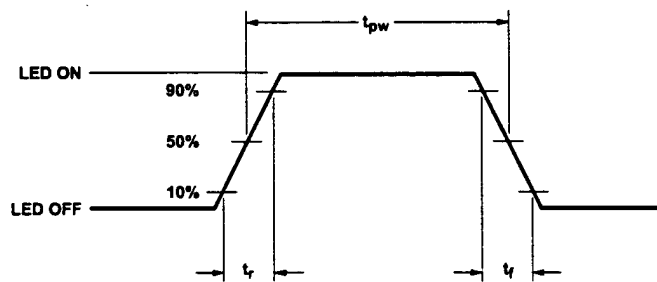
## TXD "Stuck ON" Protection



### RXD Output Waveform

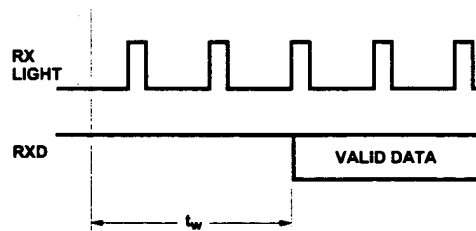


### LED Optical Waveform



### Receiver Wake Up Time Definition

(when MD0  $\neq$  1 and MD1  $\neq$  0)

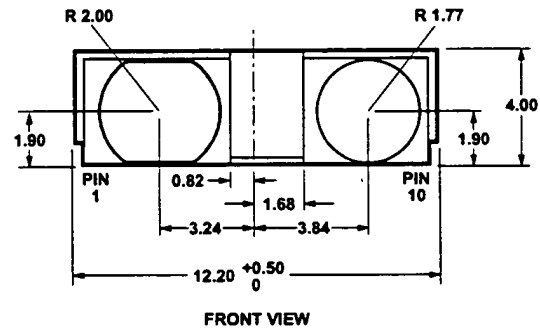
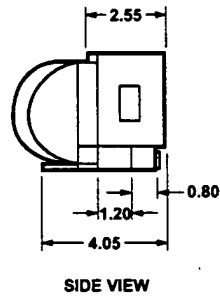
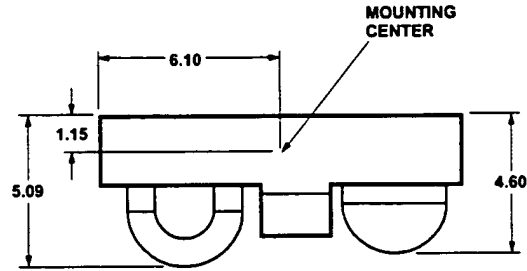




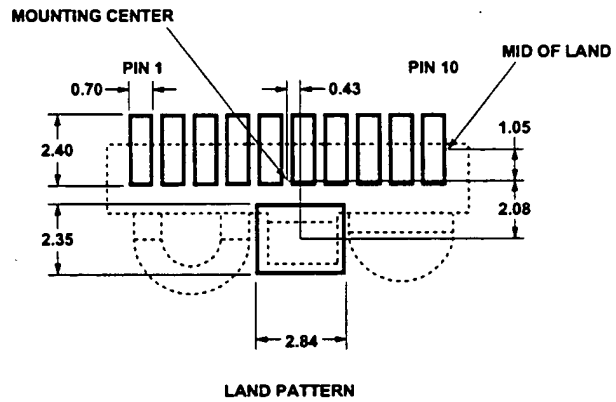
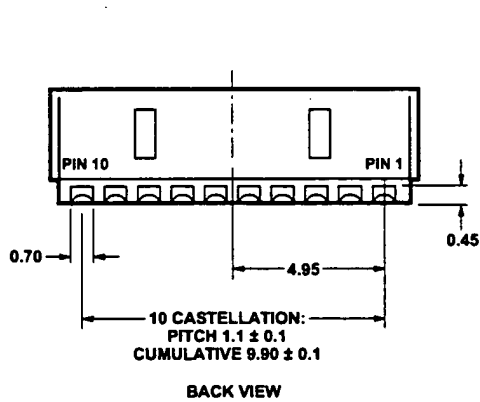
# HSDL-3610#007 and HSDL3610#017 Package Outline with Dimension and Recommended PC Board Pad Layout

HSDL-3610#007/#017  
(Front Option)

| PIN | FUNCTION | PIN | FUNCTION |
|-----|----------|-----|----------|
| 1   | VCC      | 6   | NC       |
| 2   | AGND     | 7   | GND      |
| 3   | GND      | 8   | RXD      |
| 4   | MD0      | 9   | TXD      |
| 5   | MD1      | 10  | LEDA     |



ALL DIMENSIONS IN MILLIMETERS (mm).  
DIMENSION TOLERANCE IS 0.20 mm  
UNLESS OTHERWISE SPECIFIED.

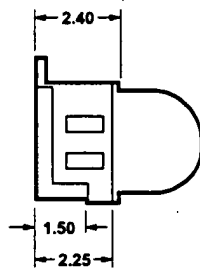
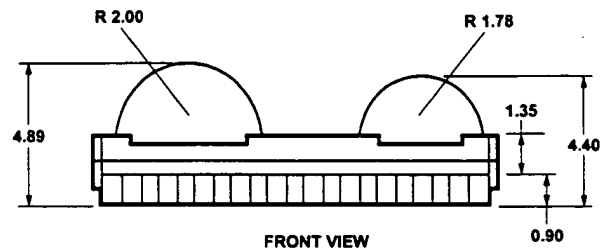


# HSDL-3610#008 and HSDL3610#018 Package Outline with Dimension and Recommended PC Board Pad Layout

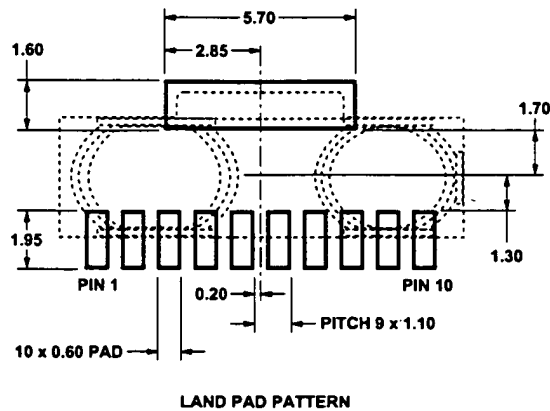
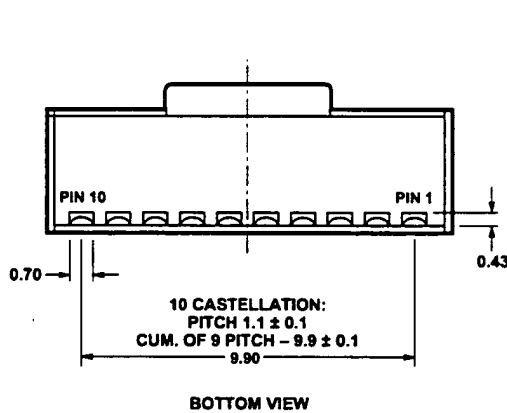
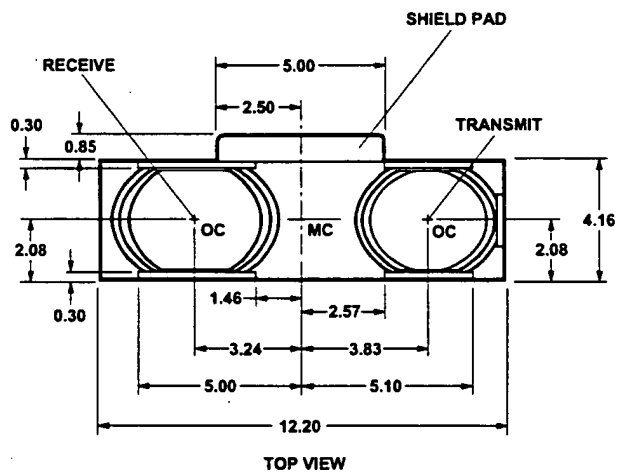
## HSDL-3610#008/#018 (Top Option)

| PIN | FUNCTION | PIN | FUNCTION |
|-----|----------|-----|----------|
| 1   | VCC      | 6   | NC       |
| 2   | AGND     | 7   | GND      |
| 3   | GND      | 8   | RXD      |
| 4   | MD0      | 9   | TXD      |
| 5   | MD1      | 10  | LEDA     |

**LEGEND:**  
MC – MOUNTING CENTER  
OC – OPTICAL CENTER



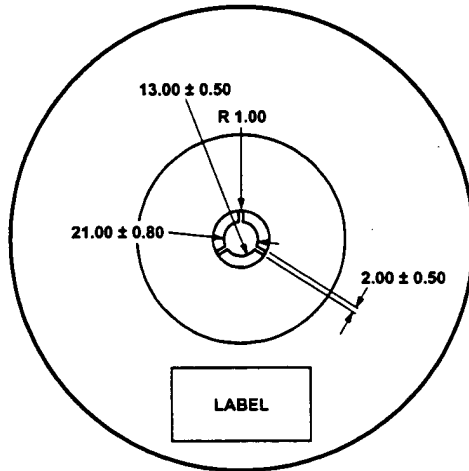
ALL DIMENSIONS IN MILLIMETERS (mm).  
DIMENSION TOLERANCE IS 0.20 mm  
UNLESS OTHERWISE SPECIFIED.



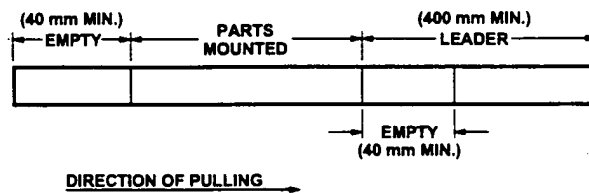
## Tape and Reel Dimensions (HSDL-3610#007, #017)

All dimensions in millimeters (mm)

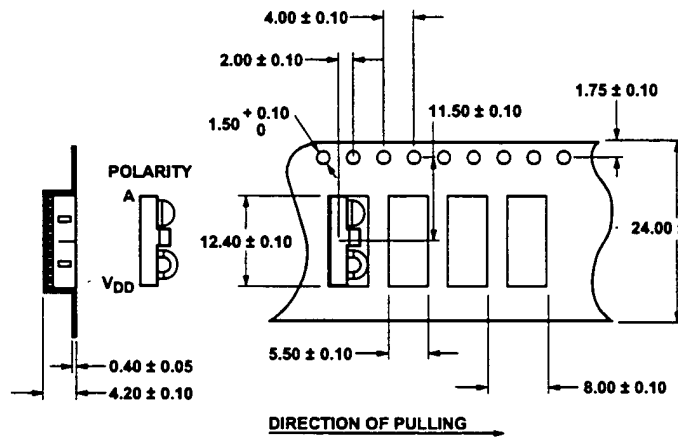
Quantity = 400 pieces per reel (HSDL-3610#007)  
10 pieces per tape (HSDL-3610#017)



SHAPE AND DIMENSIONS OF REELS



CONFIGURATION OF TAPE

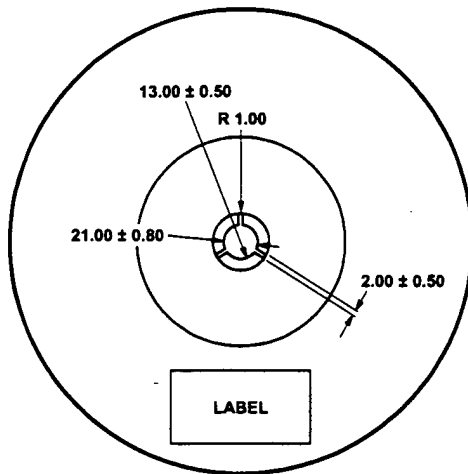


TAPE DIMENSIONS

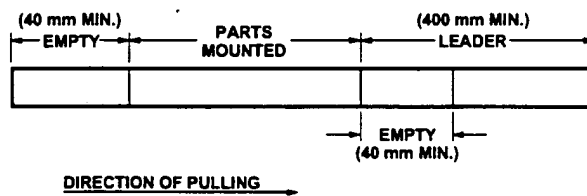
## Tape and Reel Dimensions (HSDL-3610#008, #018)

All dimensions in millimeters (mm)

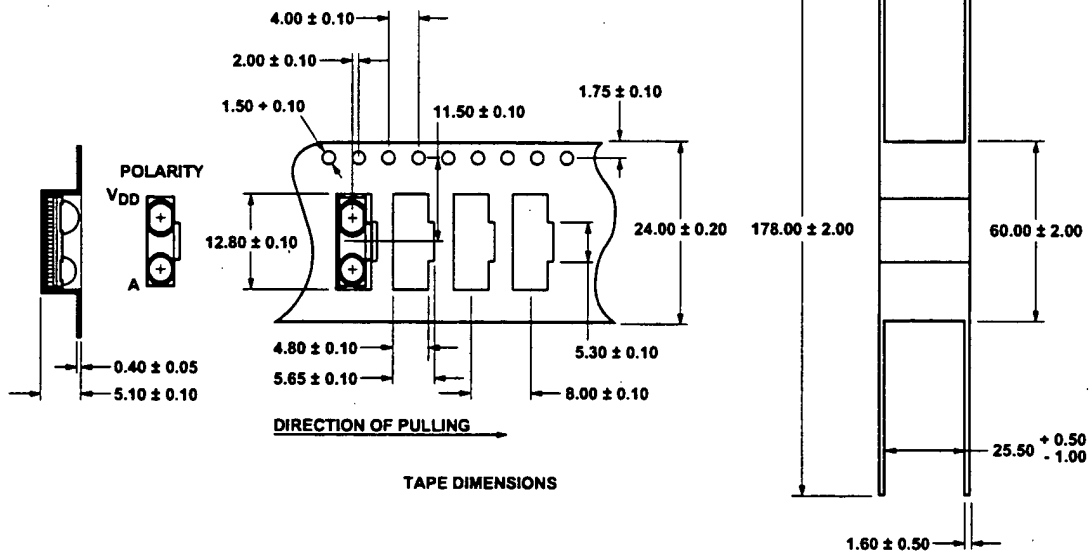
Quantity = 400 pieces per reel (HSDL-3610#008)  
10 pieces per tape (HSDL-3610#018)



SHAPE AND DIMENSIONS OF REELS



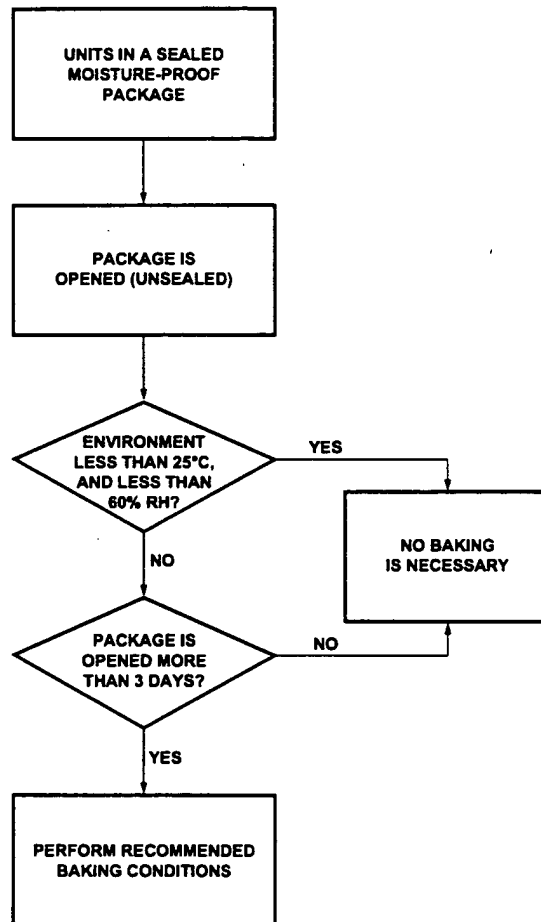
CONFIGURATION OF TAPE



TAPE DIMENSIONS

### Moisture Proof Packaging

All HSDL-3610 options are shipped in moisture proof package.  
Once opened, moisture absorption begins.



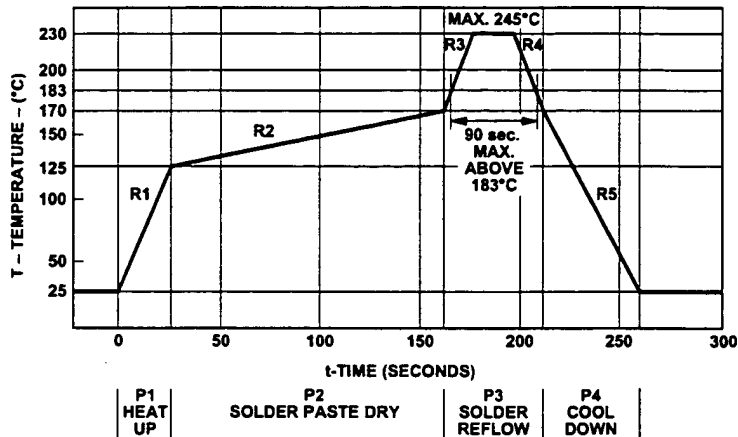
### Baking Conditions

If the parts are not stored in dry conditions, they must be baked before reflow to prevent damage to the parts.

| Package | Temperature | Time       |
|---------|-------------|------------|
| In Reel | 60°C        | ≥ 48 hours |
| In Bulk | 100°C       | ≥ 4 hours  |
|         | 125°C       | ≥ 2 hours  |

Baking should only be done once.

## Reflow Profile



| Process Zone     | Symbol | $\Delta T$                                   | Maximum $\Delta T/\Delta \text{time}$ |
|------------------|--------|--|---------------------------------------|
| Heat Up          | P1, R1 | 25°C to 125°C                                | 4°C/s                                 |
| Solder Paste Dry | P2, R2 | 125°C to 170°C                               | 0.5°C/s                               |
| Solder Reflow    | P3, R3 | 170°C to 230°C                               | 4°C/s                                 |
|                  | P3, R4 | (245°C at 10 seconds max.)<br>230°C to 170°C | -4°C/s                                |
| Cool Down        | P4, R5 | 170°C to 25°C                                | -3°C/s                                |

The reflow profile is a straight-line representation of a nominal temperature profile for a convective reflow solder process. The temperature profile is divided into four process zones, each with different  $\Delta T/\Delta \text{time}$  temperature change rates. The  $\Delta T/\Delta \text{time}$  rates are detailed in the above table. The temperatures are measured at the component to printed circuit board connections.

In **process zone P1**, the PC board and HSDL-3610 castellated I/O pins are heated to a temperature of 125°C to activate the flux in the solder paste. The temperature ramp up rate, R1, is limited to 4°C per second to allow for even heating of both the PC board and HSDL-3610 castellated I/O pins.

**Process zone P2** should be of sufficient time duration (> 60 seconds) to dry the solder paste. The temperature is raised to a level just below the liquidus point of the solder, usually 170°C (338°F).

**Process zone P3** is the solder reflow zone. In zone P3, the temperature is quickly raised above the liquidus point of solder to 230°C (446°F) for optimum results. The dwell time above the liquidus point of solder should be between 15 and 90 seconds. It usually takes about 15 seconds to assure proper coalescing of the solder balls into liquid solder and the formation of good solder connections. Beyond a dwell time of 90 seconds, the intermetallic growth within the solder connections becomes excessive,

resulting in the formation of weak and unreliable connections. The temperature is then rapidly reduced to a point below the solidus temperature of the solder, usually 170°C (338°F), to allow the solder within the connections to freeze solid.

**Process zone P4** is the cool down after solder freeze. The cool down rate, R5, from the liquidus point of the solder to 25°C (77°F) should not exceed -3°C per second maximum. This limitation is necessary to allow the PC board and HSDL-3610 castellated I/O pins to change dimensions evenly, putting minimal stresses on the HSDL-3610 transceiver.

## Appendix A: Test Method

### A1. Background Light and Electromagnetic Field

There are four ambient interference conditions in which the receiver is to operate correctly. The conditions are to be applied separately:

1. Electromagnetic field:  
3 V/m maximum (please refer to IEC 801-3, severity level 3 for details).
2. Sunlight:  
10 kilolux maximum at the optical port. This is simulated with an IR source having a peak wavelength within the range of 850 nm to 900 nm and a spectral width of less than 50 nm biased to provide  $490 \mu\text{W}/\text{cm}^2$  (with no modulation) at the optical port. The light source faces the optical port.

This simulates sunlight within the IrDA spectral range. The effect of longer wavelength radiation is covered by the incandescent condition.

3. Incandescent Lighting:  
1000 lux maximum. This is produced with general service, tungsten-filament, gas-filled, inside frosted lamps in the 60 Watt to 100 Watt range to generate 1000 lux over the horizontal surface on which the equipment under test rests. The light sources are above the test area. The source is expected to have a filament temperature in the 2700 to 3050 Kelvin range and a spectral peak in the 850 to 1050 nm range.

4. Fluorescent Lighting:  
1000 lux maximum. This is simulated with an IR source having a peak wavelength within the range of 850 nm to 900 nm and a spectral width of less than 50 nm biased and modulated to provide an optical square wave

signal ( $0 \mu\text{W}/\text{cm}^2$  minimum and  $0.3 \mu\text{W}/\text{cm}^2$  peak amplitude with 10% to 90% rise and fall times less than or equal to 100 ns) over the horizontal surface on which the equipment under test rests. The light sources are above the test area. The frequency of the optical signal is swept over the frequency range from 20 kHz to 200 kHz.

Due to the variety of fluorescent lamps and the range of IR emissions, this condition is not expected to cover all circumstances. It will provide a common floor for IrDA operation.

All IR transceivers operating under the recommended drive conditions are classified as CENELEC EN60825-1 Accessible Emission Limit (AEL) Class 1. This standard is in effect in Europe as of January 1, 1997. AEL Class 1 LED devices are considered eye safe. Please see Application Note 1094 for more information.

## Appendix B: HSDL-3610#007/#017 SMT Assembly Application Note

### 1.0 Solder Pad, Mask and Metal Solder Stencil Aperture

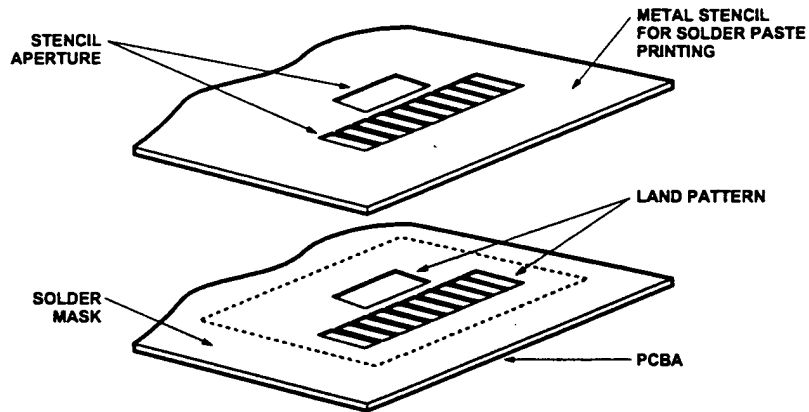


Figure 1.0. Stencil and PCBA.

### 1.1 Recommended Land Pattern for HSDL-3610#007/#017

| Dim.      | mm   | Inches |
|-----------|------|--------|
| a         | 2.40 | 0.095  |
| b         | 0.70 | 0.028  |
| c (pitch) | 1.10 | 0.043  |
| d         | 2.35 | 0.093  |
| e         | 2.80 | 0.110  |
| f         | 3.13 | 0.123  |
| g         | 4.31 | 0.170  |

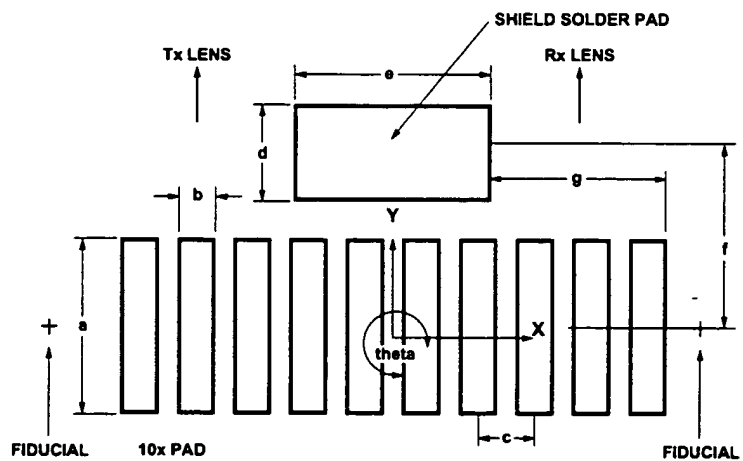


Figure 2.0. Top View of Land Pattern.



## 1.2 Adjacent Land Keep-out and Solder Mask Areas

| Dim.     | mm       | Inches     |
|----------|----------|------------|
| <i>h</i> | min. 0.2 | min. 0.008 |
| <i>j</i> | 13.4     | 0.528      |
| <i>k</i> | 4.7      | 0.185      |
| <i>l</i> | 3.2      | 0.126      |

Note: Wet/Liquid Photo-Imaginable solder resist/mask is recommended.

- Adjacent land keep-out is the **maximum space** occupied by the unit relative to the land pattern. There should be no other SMD components within this area.
- “*h*” is the minimum solder resist strip width required to avoid solder bridging adjacent pads.
- It is recommended that 2 fiducial cross be placed at mid-length of the pads for unit alignment.

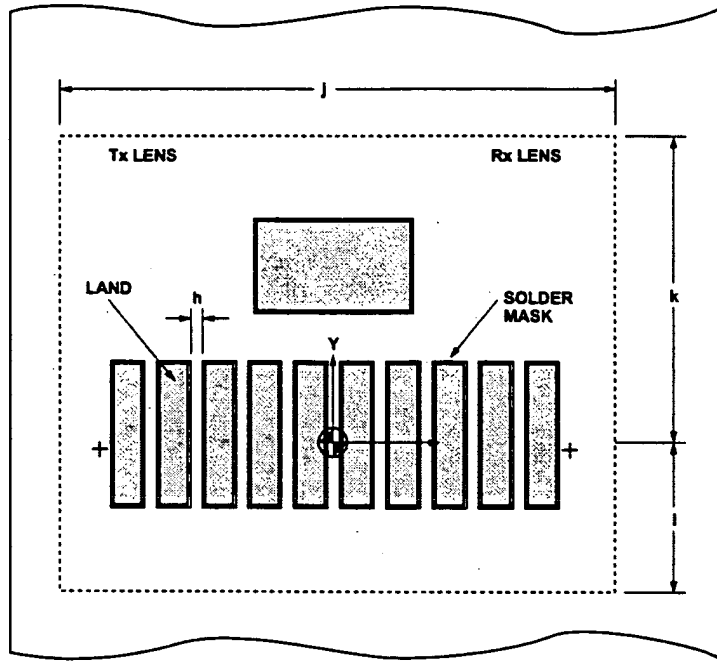


Figure 3.0. HSDL-3610#007/#017 PCBA – Adjacent Land Keep-out and Solder Mask.

## 2.0 Recommended Solder Paste/cream Volume for Castellated Joints

Based on calculation and experiment, the printed solder paste volume required per castellated pad is 0.30 cubic mm (based on either no-clean or aqueous solder cream types with typically 60 to 65% solid content by volume).

### 2.1 Recommended Metal Solder Stencil Aperture

It is recommended that only 0.152 mm (0.006 inches) or 0.127 mm (0.005 inches) thick stencil be used for solder paste

printing. This is to ensure adequate printed solder paste volume and no shorting. The following combination of metal stencil aperture and metal stencil thickness should be used:

| See Fig 4.0  |        |                               |                   |
|--|--------|-------------------------------|-------------------|
| <i>t</i> , nominal stencil thickness                                       |        | <i>l</i> , length of aperture |                   |
| mm   | inches | mm                            | inches            |
| 0.152  | 0.006  | $2.8 \pm 0.05$                | $0.110 \pm 0.002$ |
| 0.127  | 0.005  | $3.4 \pm 0.05$                | $0.134 \pm 0.002$ |
| <i>w</i> , the width of aperture is fixed at 0.70 mm (0.028 inches)        |        |                               |                   |
| Aperture opening for shield pad is 2.8 mm x 2.35 mm as per land dimensions |        |                               |                   |

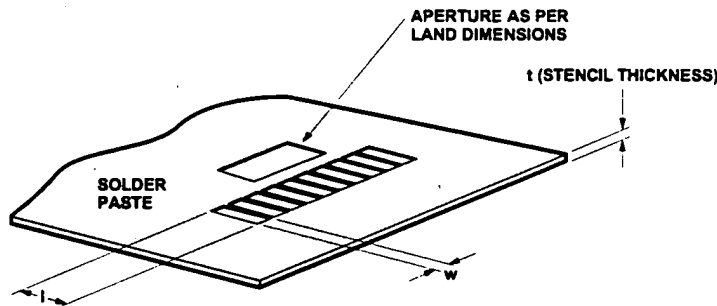


Figure 4.0. Solder Paste Stencil Aperture.

### 3.0 Pick and Place Misalignment Tolerance and Product Self-Alignment after Solder Reflow

If the printed solder paste volume is adequate, the unit will self-align in the X-direction after solder reflow. Units should be properly reflowed in IR Hot Air convection oven using the recommended reflow profile. The direction of board travel does not matter.

#### Allowable Misalignment Tolerance

|                   |                              |
|-------------------|------------------------------|
| X - direction     | $\leq 0.2$ mm (0.008 inches) |
| Theta - direction | $\pm 2$ degrees              |

### 3.1 Tolerance for X-axis Alignment of Castellations

Misalignment of castellation to the land pad should not exceed 0.2 mm or approximately half the width of the castellation during

placement of the unit. The castellations will completely self-align to the pads during solder reflow as seen in the pictures below.



Photo 1.0. Castellation misaligned to land pads in x-axis before reflow.

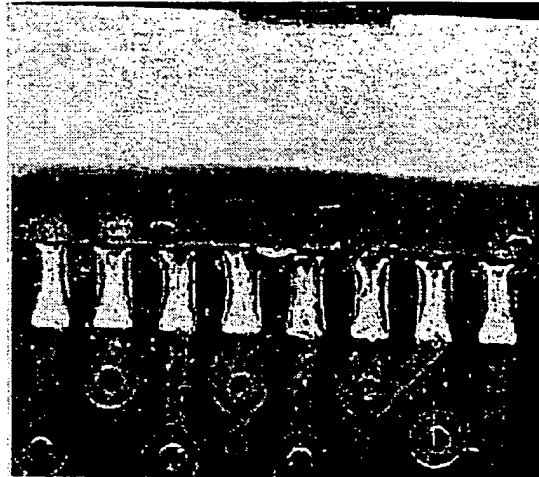


Photo 2.0. Castellation self-align to land pads after reflow.

### 3.2 Tolerance for Rotational (Theta) Misalignment

Units when mounted should not be rotated more than  $\pm 2$  degrees with reference to center X-Y as specified in Fig 2.0. Pictures 3.0 and 4.0 show units before and

after reflow. Units with a Theta misalignment of more than 2 degrees do not completely self-align after reflow. Units with  $\pm 2$  degree rotational or Theta misalignment self-aligned completely after solder reflow.

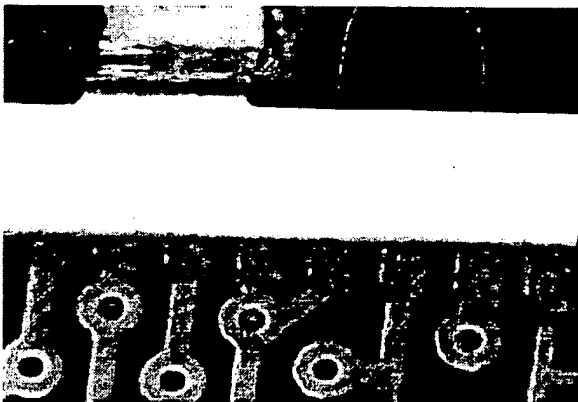


Photo 3.0. Unit is rotated before reflow.

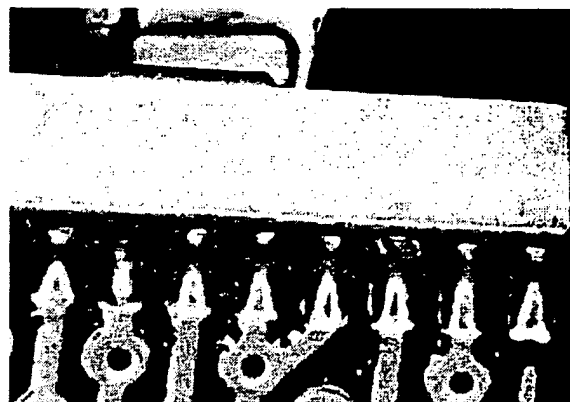


Photo 4.0. Unit self-aligns after reflow.

### 3.3 Y-axis Misalignment of Castellation

In the Y-direction, the unit does not self-align after solder reflow. It is recommended that the unit be placed in line with the fiducial

mark (mid-length of land pad.) This will enable sufficient land length (minimum of  $\frac{1}{2}$  land length.) to form a good joint. See Fig 5.0.

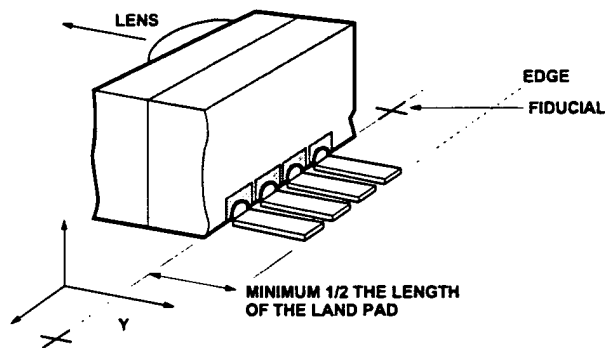


Figure 5.0. Section of a Castellation in Y-axis.

### 3.4 Example of Good HSDL-3610#007/#017 Castellation Solder Joints

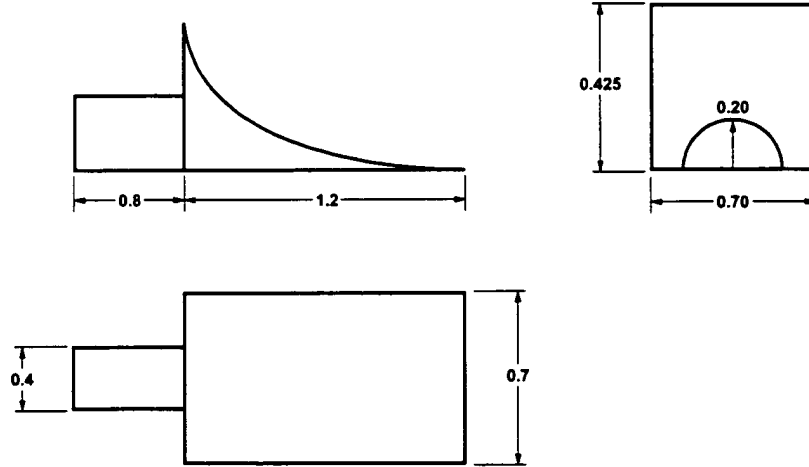


Photo 5.0. Good Solder Joint.

This joint is formed when the printed solder paste volume is adequate, i.e. 0.30 cubic mm and reflowed properly. It should be reflowed in IR Hot-air convection reflow oven. Direction of board travel does not matter.

#### 4.0 Solder Volume Evaluation and Calculation

Geometry of an HSDL-3610#007/#017 solder fillet.



## Appendix C : HSDL-3610#008/#018 SMT Assembly Application Note

### 1.0 Solder Pad, Mask and Metal Solder Stencil Aperture

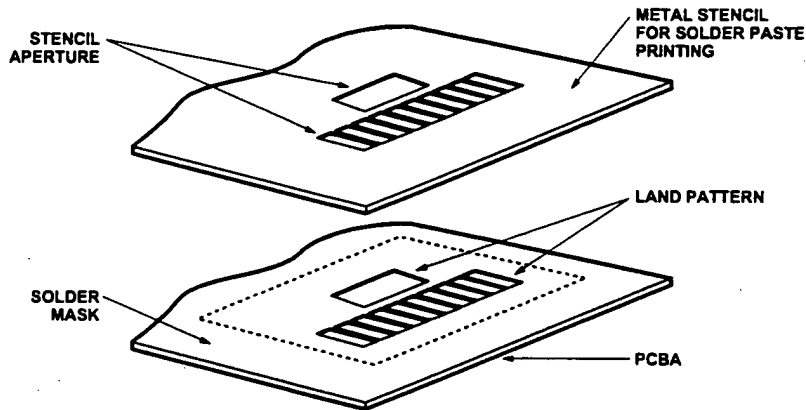


Figure 1.0. Stencil and PCBA.

### 1.1 Recommended Land Pattern for HSDL-3610#008/#018

| Dim.      | mm   | Inches |
|-----------|------|--------|
| a         | 1.95 | 0.077  |
| b         | 0.60 | 0.024  |
| c (pitch) | 1.10 | 0.043  |
| d         | 1.60 | 0.063  |
| e         | 5.70 | 0.224  |
| f         | 3.80 | 0.150  |
| g         | 2.40 | 0.094  |
| h         | 0.80 | 0.032  |

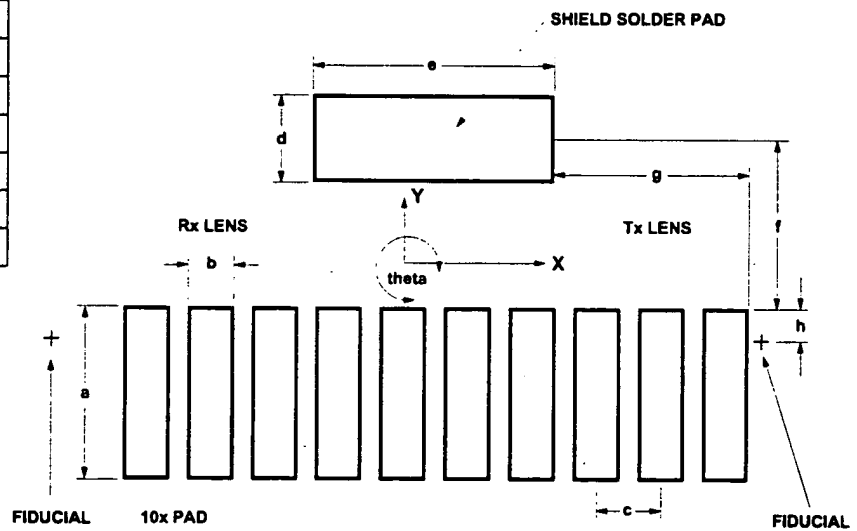


Figure 2.0. Top View of Land Pattern.

## 1.2 Adjacent Land Keep-out and Solder Mask Areas

| Dim. | mm       | Inches     |
|------|----------|------------|
| $h$  | min. 0.2 | min. 0.008 |
| $j$  | 13.4     | 0.528      |
| $k$  | 5.8      | 0.228      |
| $l$  | 3.5      | 0.130      |

- Adjacent land keep-out is the **maximum space** occupied by the unit relative to the land pattern. There should be no other SMD components within this area.
- “ $h$ ” is the minimum solder resist strip width required to avoid solder bridging adjacent pads.
- It is recommended that 2 fiducial cross be placed at mid-length of the pads for unit alignment.

Note: Wet/Liquid Photo-Imaginable solder resist/mask is recommended.

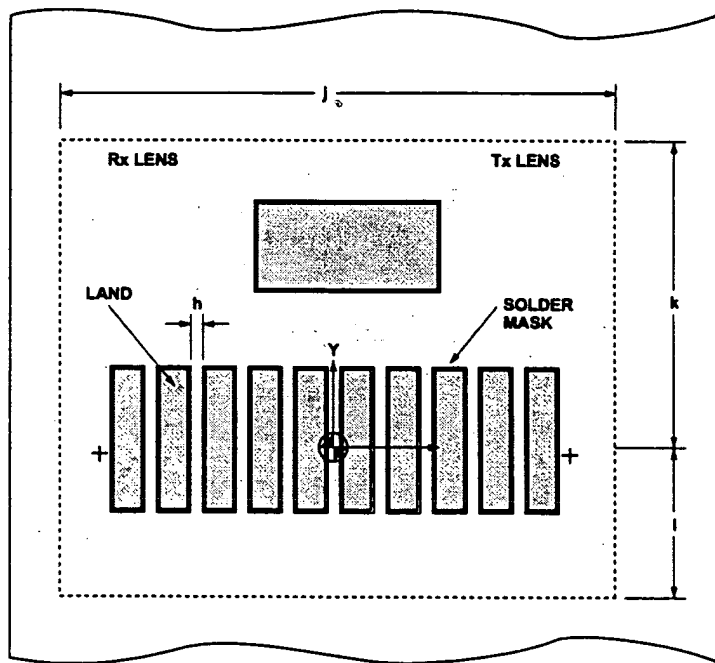


Figure 3.0. HSDL-3610#008/#018 PCBA – Adjacent Land Keep-out and Solder Mask.

## 2.0 Recommended Solder Paste/cream Volume for Castellated Joints

Based on calculation and experiment, the printed solder paste volume required per castellated pad is 0.28 cubic mm (based on either no-clean or aqueous solder cream types with typically 60 to 65% solid content by volume).

### 2.1 Recommended Metal Solder Stencil Aperture

It is recommended that only 0.152 mm (0.006 inches) or 0.127 mm (0.005 inches) thick stencil be used for solder paste

printing. This is to ensure adequate printed solder paste volume and no shorting. The following combination of metal stencil aperture and metal stencil thickness should be used:

| See Fig 4.0   |        |                               |                   |
|---|--------|-------------------------------|-------------------|
| <i>t</i> , nominal stencil thickness                                      |        | <i>l</i> , length of aperture |                   |
| mm  | inches | mm                            | inches            |
| 0.152   | 0.006  | $3.1 \pm 0.05$                | $0.122 \pm 0.002$ |
| 0.127   | 0.005  | $3.7 \pm 0.05$                | $0.147 \pm 0.002$ |
| <i>w</i> , the width of aperture is fixed at 0.60 mm (0.024 inches)       |        |                               |                   |
| Aperture opening for shield pad is 5.7 mm x 1.6 mm as per land dimensions |        |                               |                   |

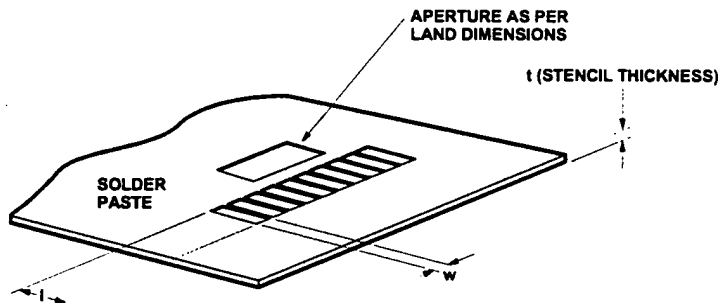


Figure 4.0. Solder Paste Stencil Aperture.

### 3.0 Pick and Place Misalignment Tolerance and Product Self-Alignment after Solder Reflow

If the printed solder paste volume is adequate, the unit will self-align in X-direction after solder reflow. Units should be properly reflowed in IR Hot Air convection oven using the recommended reflow profile. The direction of board travel does not matter.

#### Allowable Misalignment Tolerance

| X - direction | $\leq 0.2 \text{ mm (0.008 inches)}$ |
|---------------|--------------------------------------|
|---------------|--------------------------------------|



### 3.1 Tolerance for X-axis Alignment of Castellations

Misalignment of castellation to the land pad should not exceed 0.2 mm or approximately half the width of the castellation during

placement of the unit. The castellations will completely self-align to the pads during solder reflow as seen in the pictures below.

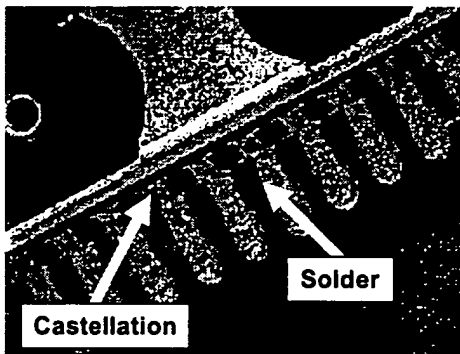


Photo 1.0. Castellation mis-aligned to land pads in X-axis before reflow.

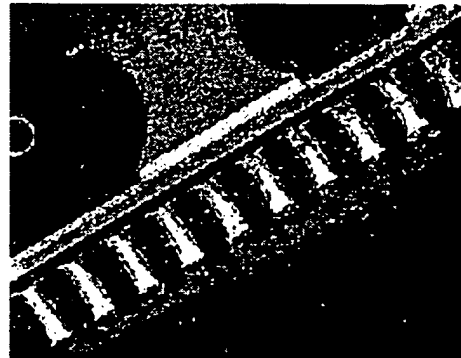


Photo 2.0. Castellation self-aligned to land pads after reflow.

### 3.2 Tolerance for Rotational (Theta) Misalignment

Units when mounted should not be rotated more than  $\pm 1$  degrees with reference to center X-Y as specified in Fig 2.0. Pictures 3.0

and 4.0 show that unit cannot be self-aligned back due to the small wetting force. Units with a Theta misalignment of more than 1 degree do not completely self-align after reflow.

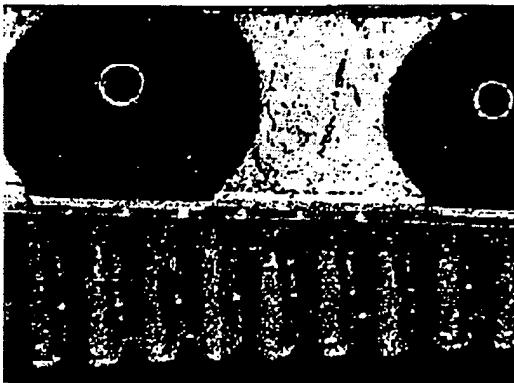


Photo 3.0. Unit is rotated before reflow.

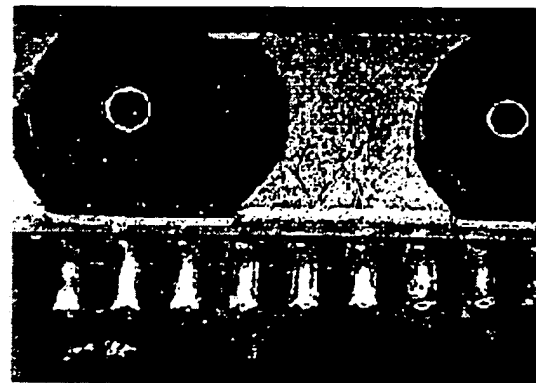


Photo 4.0. Unit not self-aligned after reflow.

### 3.3 Y-axis Misalignment of Castellations

In the Y-direction, the unit does not self align after solder reflow. It is recommended that the unit be placed in line with the fiducial mark. This will enable sufficient land length to form a good joint. See Fig. 5.0.

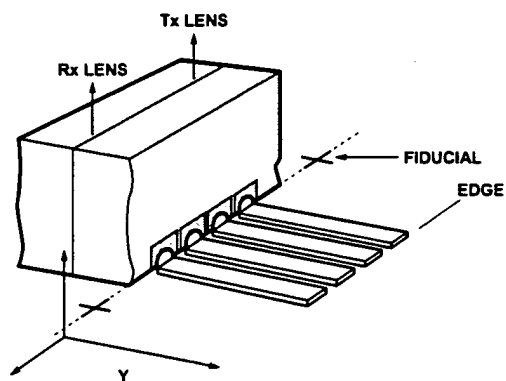


Figure 5.0. Section of a Castellations in Y-axis.

### 3.4 Example of Good Castellations Solder Joints

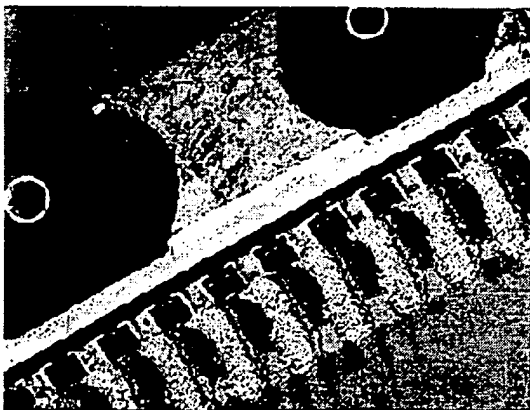


Photo 6.0. Good Attachment before Reflow.

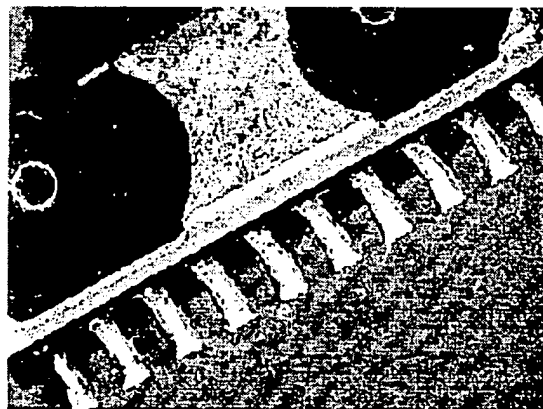


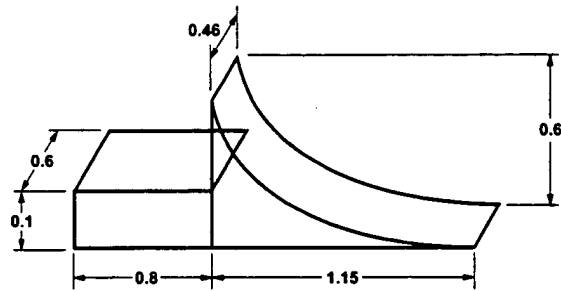
Photo 7.0. Good Solder Joint after Reflow.

This joint is formed when the printed solder paste volume is adequate, i.e. 0.30 cubic mm and reflowed properly. It should be

reflowed in IR Hot-air convection reflow oven. Direction of board travel does not matter.

#### 4.0 Solder Volume Evaluation and Calculation

Geometry of an HSDL-3610#008/#018 solder fillet.



$$V_{\text{solder}} = (0.8 \times 0.6 \times 0.1) + (0.5 \times 0.6 \times 0.46 (0.6 + 1.15)/2) = 0.1662 \text{ mm}^3$$

$$V_{\text{paste}} = V_{\text{solder}}/0.6 = 0.277 \text{ mm}^3$$



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Obsoletes 5980-1767E (6/00)

5988-2314EN